3. Other Problems With the Hatfield Model's Cost Estimates

There are several other problems with the Hatfield model that can cause an understatement of a LEC's actual costs.

First, the Hatfield model's calculation of switching costs contains several inaccuracies and anomalies. As pointed out by Tardiff, the model matches a 1994 forecasted switch price with a 1993 average embedded switch size. The model assumes three switch sizes: small, medium, and large, and assembles prices and average sizes for them from numerous sources. While independent LECs *excluding* GTE are used for the small switch price, the model nevertheless includes GTE in estimating the average small switch size. Also, the model equates the average size of an *installed* switch with the average size of a *new* switch, a dubious assumption at best.[16]

Second, the Hatfield model's relationship between the cost of switching per line and the size of the switch is developed from only three data points. It also produces switching cost estimates that are lower than, and inconsistent with, those produced by the BCM. For example, the Hatfield model takes as a data point that a medium size switch with an average of 11,200 lines would have a switching cost per line of $104. In contrast, the BCM estimates[17] that a switch of size 11,000 lines (closest to the Hatfield number) would have a per line cost of $298. Even though the BCM reports cost for a DMS-100 switch, and it is not immediately clear what switch type the Hatfield model has in mind, the discrepancy in the per line estimate of cost is significant enough to warrant a critical second look at Hatfield's claimed relationship between switch size and per line cost.

Third, the Hatfield model appears to assume that LECs serve new demand only by installing *new* switches. In fact, Tardiff cites a McGraw-Hill report[18] that LECs frequently buy additional lines for their already *installed* switches, and that those additional lines each cost more than lines on new switches. Switch suppliers frequently sell initial lines at deep discounts, but not so the lines added subsequently. By failing to account for the LECs' practice of adding lines to installed switches for serving new demand, the Hatfield model very likely understates actual switching costs. In effect, by assuming that LECs only add capacity by installing new switches, the Hatfield model "builds in" the lowest possible switch prices into its switching cost estimates.

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[16] Tardiff, *op cit.*, pp. 12-13.

[17] *Benchmark Cost Model,* Attachment 1.

[18] Tardiff, *op cit.*, p. 13.

Fourth, the Hatfield model makes no effort to capture the alternative ways that a LEC may choose to expand its switch capacity. Recall that the Hatfield model utilizes fill factors for loop plant and switching equipment that are considerably greater than those actually reported by LECs. In addition, when developing the costs of wire center investments, the model first fixes the maximum effective switch size — the "large" switch — at 80,000 lines (assuming a fill factor of 80% for a 100,000 line switch). Next, it equips a wire center with only one such switch as long as the line count served is between 0 and 80,000. However, if the served line count rises to 90,000, the model recomputes the investment as that required for *two* 45,000-line switches (expressed net of the assumed fill factor). That is, the demand for the last 10,000 lines over the first 80,000 is not assumed to be served by a new switch that is added to the 100,000-line switch already in use The Hatfield model approach of resizing *all* switches imparts to the LEC the remarkable ability to reconfigure and optimize its network, both instantaneously and without any additional adjustment cost. In the real world, LECs do not add capacity in this manner. Instead of instantly resizing and replacing its existing switch(es), a LEC would more likely respond by either adding lines to the existing switch or adding another switch.

The LEC may decide to add a second 100,000-line switch because it expects significant demand growth. The Hatfield model's instant resizing algorithm does not recognize that, in the real world, investment decisions are often irreversible because of the substantial costs associated with (i) scrapping and disposing of older but functioning equipment and (ii) instantaneous and continual network reconfiguration. Nor, in the face of uncertain market demand, can that model foresee a LEC's reasons for wishing to add a 100,000-line switch instead of a smaller switch. Often, the addition of larger equipment may entail higher *initial* costs (including the cost of spare capacity) as well as higher inventory carrying costs, but such equipment may also produce economies of scale and scope and the ability to respond to quickly surging demand. Every LEC has to confront these trade-offs and choices according to its best forecast of future demand. To be able to account for this, a cost model would need to be far more "intelligent" and adaptable than the Hatfield model currently is.

Finally, the Hatfield model resorts to multiplicative factors to account for the cost of structures used to house copper and fiber cable and for network and non-network operating expenses. In the absence of direct observations on these costs and expenses, the model can only apply these factors to observed entities like cable prices or historical revenues/line demand. The use of such factors can create some important measurement problems. For example, the cost of housing structure for cable is calculated by multiplying the cable price by the appropriate structure factor. The resulting "cost" can easily change as the price of cable changes, even though the real underlying cost of the structure may not. Also, the use of historical investment-expense ratios (developed from ARMIS reports) to calculate forward-looking operating costs is completely contrary to the Hatfield model's basic underpinning — that past costs, based on past technologies, cannot represent the costs of newer, more efficient technologies. It is inconceivable that as technologies change and become cheaper, operating expenses will not follow suit.

4. Conclusion

The Hatfield model is replete with assumptions about technical parameters that do not necessarily resemble a LEC's actual situation. Its sponsors claim that the model is flexible enough to accept non-proprietary LEC-specific inputs. That would suggest that the model itself should remain a valid instrument for calculating a LEC's actual costs, even if the costs it currently reports using hypothetical inputs are disregarded. Our objection to the Hatfield model is at a more fundamental level. While LEC-specific inputs could conceivably bring the model's cost outcomes closer to reality, we believe that a purely engineering model like the Hatfield can never expect to fully reproduce or explain all the actual booked costs reported by a LEC. We discuss the reasons for these below. For now, we conclude that the Hatfield model, powered in large part by the BCM and hypothetical technical parameters that disregard the choices a LEC actually faces cannot possibly expect to produce the actual costs of that LEC.

C. The Hatfield Model Cannot Produce Costs That Reflect Changing Market or Regulatory Environments

1. Hypothetical Efficiency *v.* Reasonably Achievable Efficiency

As we stated earlier, the Hatfield model appears to rely on a set of unstated economic assumptions. If those assumptions were true, not just fictitious networks but actual LECs would experience costs lower than those they actually report. The first problem with those assumptions is that they invoke a perfect and friction-less world where the ideal of perfectly optimized networks is achieved at all times, even in times of sweeping market and regulatory change. While the costs yielded under such assumptions may be closer to those produced by purely engineering models that have embedded in them best engineering and cost-minimizing practices, the real world often produces sources of cost that engineering models cannot predict in advance. Therefore, what is "efficient" from a hypothetical *engineering* and friction-less standpoint may be quite different from the efficiency that can reasonably be achieved by actually operating networks. Unit costs yielded by models such as the BCM or the Hatfield can, at best, provide lower bounds for unit costs of efficient networks in practice.[19] That is why booked costs (that include the consequences of network actions actually undertaken) usually exceed costs derived from a hypothetical bottoms-up approach. Only real costs have real consequences; therefore, public policy deliberations need to be informed by costs as they actually are, not as they could be in a perfect friction-less world.

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[19] Actually, the BCM or Hatfield model provides a lower bound for forward-looking costs which, *in turn*, provide lower bounds for actual or booked costs.

The primary economic issues at stake here concern the manner in which the Hatfield model deals with a changing market and regulatory environment. A dynamic environment tests the stability and flexibility of a cost model, and the following discussion examines that issue in depth.

2. Hypothetical Costs in a Dynamic Environment

Local exchange competition and more relaxed regulation of incumbent LECs are expected to alter fundamental and long-standing public policy arrangements regarding universal service, the pricing of regulated services, and access to the networks of incumbent carriers. Given the Telecommunications Act's prescription that the cost of any universal service program should be shared in a competitively neutral way by *all* providers of service, the priority is now to determine the cost of that program as a prelude to determining the burden share of each service provider.

The Hatfield model and its predecessor, the BCM, have been offered as instruments for determining what basic residential exchange service *should* cost in a world of perfectly optimized networks. The implication is that any excess of an incumbent LEC's actual cost over the benchmark or threshold cost established by the Hatfield model should be attributed strictly to the incumbent's inherent inefficiencies and, therefore, be declared ineligible for recovery through the rates for the incumbent's regulated services. Put another way, the incumbent LEC's actual cost should be compared to a hypothetical optimized network's cost, and any excess actual cost should be disallowed for recovery through the universal service funding system.

There are two fundamental problems with this message. First, if the hypothetical optimized network can never be reasonably achieved by the incumbent LEC, then of what value can the comparison be? Even though the present Hatfield model describes itself as a "scorched node" model, its earlier version[20] had been of a "scorched earth" or "greenfield" variety, namely, one that compared the incumbent LEC to a start-up network that had the complete freedom to implement the most efficient forward-looking technologies without any regard for the past. While a new entrant LEC could aspire to being that start-up network, it is ludicrous to believe that that could be true of incumbent LECs with long histories in the business.

Second, in view of the fact that unexpected costs do arise under actual operation, even the most "efficient" LEC can expect its actual costs to exceed the costs produced by the engineering bottoms-up approach. This is the real world with friction, one in which not every aspect of a LEC's operations can be predicted, and its consequences evaluated, in advance. Even LECs that adopt cost-minimizing production techniques based on forward-looking technologies must contend with the vagaries of uncertain demand in a changing and competitive marketplace or unexpected developments like political or policy change and catastrophic weather events. Therefore, the Hatfield model's implicit message that any cost in excess of that calculated by the model should be attributed to unproven inefficiencies is overly simplistic and utterly misleading. There is no simple or expedient way to distinguish a LEC's excess actual costs under efficient operation from costs due to inefficiency.

All of these reasons make us skeptical of the benchmark costs produced by models of hypothetical networks. Networks that do not recover their actual costs will, over time, go out of business. With the introduction of competition, LECs — incumbent and entrants alike — will have every incentive to lower their *actual* costs. Those that succeed will survive and qualify for support from the revamped universal service funding system. Such a market solution would be infinitely better than one based on the comparison of a LEC's actual costs to the benchmark costs of a hypothetical network.

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[20] Hatfield Associates, Inc., *The Cost of Basic Universal Service*, prepared for MCI Communications Corporation, July 1994.

3. The Hatfield Model Pretends that Incumbent and Entrant LECs Should be Alike

Even with the less extreme scorched node orientation, the Hatfield model ascribes to its cost model the property of producing the least-cost network that "... an efficient LEC would adopt if it were to begin today to rebuild its telephone service network from the bottom up."[21] We interpret this to mean that an efficient LEC, at any given time, would have in place the same network that an entrant might choose to build. However, the direction in which an efficient incumbent LEC may take its existing network need not be the same as that taken by an "equally efficient" entrant LEC. The incumbent is constrained by its past choices that resulted in its present network. Because of this, it is quite probable that the incumbent LEC would make different technology choices than the entrant. Therefore, costs calculated for an efficient start-up LEC may well differ from those of an efficient incumbent LEC that is necessarily constrained by its past. Again, what matters for determining the cost of the universal service program is not the idealized cost of a start-up LEC, but rather the actual costs of LECs participating in that program.

4. The Hatfield Model Takes an Unrealistic View of the Market Environment

The Hatfield model's greatest drawback is that it creates a world in which the best features of both competition and monopoly are magically present. This allows the model to create the illusion that competitive LECs that perforce share the existing market demand can somehow still enjoy the benefits of economies of scale and scope that only monopoly supply can bring. For example, the model uses access line demand data from carriers' 1994 ARMIS 43-08 reports and usage data from other FCC sources as inputs into its investment cost modules. Such an exercise for calculating a LEC's investment costs might be legitimate if it were safe to assume that the level of demand experienced by the LEC under monopoly conditions would remain intact even under competition. If, as we expect, that assumption is not

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[21] Hatfield Document, pp. 2-3.

tenable, the cost estimates produced by the Hatfield model for the major LEC in each of 48 states and the District of Columbia[22] also cannot be credible. Furthermore, since the Hatfield model builds in the economies of scale arising from being able to serve the higher levels of demand available under monopoly conditions, it also produces unit cost estimates that understate the true costs of competing LECs (incumbent and entrant alike) that serve smaller demand segments and, hence, do not enjoy the same scale economies.

The Hatfield model's implicit belief that certain regulated monopoly features would persist under competition is apparent in the manner in which it incorporates depreciation rates and the weighted cost of capital into its expense module. First, the Hatfield model appears to choose depreciation rates that are even below the BCM's unrealistically low rate of depreciation (an annual rate of 5.7 per cent) for outside loop plant. In addition, it assigns equally low depreciation rates to end-office switching (an annual rate of 5 per cent). The long depreciation lives implied by these rates were actually prescribed by regulators in the past when incumbent LECs operated as regulated monopolies. Under conditions of market competition, however, such slow depreciation rates are simply unrealistic. By failing to assume depreciation rates more likely to prevail under competition, the Hatfield model produces downward-biased annual costs of plant and wire center investments.[23] The model's failure to use higher depreciation rates that would be true under competition simply does not square with the model's implicit expectation that LECs will move seamlessly to the latest, most cost-reducing technologies as and when they become available. Faced with long depreciation lives on existing plant and equipment, no firm in the real world can be expected to act as envisioned by the model.

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[22] Update of the Hatfield Model, Version 2.2, Release 1, prepared for AT&T Corporation and MCI Telecommunications Corporation by Hatfield Associates, Inc., May 30, 1996.

[23] Tardiff reports that moving from the BCM's assumed 5.7 per cent depreciation rate (corresponding to an 18-year economic life) to the book depreciation rates currently used by Regional Bell Operating Companies (RBOCs) will adjust costs upward by 12.6 per cent. See Tardiff, *op cit.*, p. 16. In addition, if AT&T's own 1994 book depreciation rate of about 11 per cent were used, costs would be adjusted upward by nearly 42 per cent.

Second, the Hatfield model calculates a weighted average cost of capital of 8.91 per cent under the assumption that the cost of debt is 7.46 per cent, the cost of equity is 11.25 per cent, the debt percentage is 61.82, and the equity percentage is 38.18. These assumptions are a marked departure from Hatfield Associates' own 1996 greenfield version of the model[24] in which it assumed the equity percentage to be a more realistic 60, and came up with a cost of capital of 10 per cent. Again, the consequence of the lower cost of capital is a lower annual cost of plant and wire center investments.[25] Professor Jerry Hausman has recently demonstrated that the increased risk and uncertainty associated with competition tends to raise annual costs by a factor of 3 to 7.[26] If the annual costs rise by a factor of 3, then the effective cost of capital or hurdle rate should be over 40%,[27] between four and five times that used by the Hatfield model.[28] Recently, the FCC itself recognized the need for states to establish "... appropriate *risk-adjusted* cost of capital and depreciation rates" for pricing purposes.[29]

V. CONCLUSION

The Hatfield model is an engineering model for estimating economic costs. It is premised on assumptions about technical parameter inputs and the belief that competing carriers continually optimize their networks. In the process, it only succeeds at producing the costs of a hypothetical carrier that (i) may never resemble the actual costs of real-world carriers and (ii) seriously underestimate those true costs.

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[24] Hatfield Associates, Inc., *The Cost of Basic Network Elements: Theory, Modeling and Policy Implications*, prepared for MCI Telecommunications Corporation, March 29, 1996.

[25] Using the relationship in the 1994 Hatfield report that a 175 basis point difference increases the cost per line by 11 per cent, Tardiff reports that increasing the cost of capital from 8.91 to 10 per cent (as in the 1996 Hatfield greenfield model report) would increase costs by about 7 per cent. And, moving to the 11.25 per cent rate of return currently allowed by the FCC for RBOCs would increase costs by 14.7 per cent over the Hatfield model estimates.

[26] Reply Affidavit of Jerry A Hausman, CC Docket 96-45, May 30, 1996.

[27] This projection is based on the Hatfield relationship between the cost per line and the cost of capital in note 24, *supra.*

[28] This accords with the finding by Lawrence Summers that for competitive firms the mean and median hurdle rates tend to exceed the cost of capital by a factor of between 2 and 10. See L. Summers, "Investment Incentives and the Discounting of Depreciation Allowances," in M. Feldstein (ed.), *The Effects of Taxation on Capital Accumulation*, Chicago: University of Chicago Press, 1987.

[29] "Commission Adopts Rules to Implement Local Competition Provisions of Telecommunications Act of 1996 (CC Docket No. 96-98)," NEWSReport No. DC 96-75, August 1, 1996.

Even the assertion that the model can be populated with LEC-specific data is misleading. First, simply replacing the model sponsors' own parameter inputs by LEC-specific inputs will not release the model from the confining assumption about continual optimization in a scorched node world. As long as real-world carriers behave differently than assumed, even LEC-specific inputs will not produce real costs. Second, no significance whatsoever can or should be attached to the cost outcomes reported in the Hatfield Document and its subsequent update on May 30, 1996. The cost estimates reported in those documents lack even indicative value because the circumstances under which they were calculated are far removed from reality.

While a model that estimates a carrier's cost of providing basic residential exchange and related services is crucial for estimating the size of and implementing a reformed universal service funding system, the Hatfield model cannot and should not be the vehicle for that purpose. Only real costs have consequences: a firm's ability to survive and function in a dynamic, competitive environment depends on its real costs — governed by real-world market and regulatory circumstances — not on hypothetical costs ascribed to it. Because the Hatfield model's basic premises about firm behavior are so far removed from reality, it cannot possibly expect to represent real costs for policy-making purposes.

Public policy on universal service reform has an understandable interest in minimizing the cost of implementing a program in which carriers need to be supported in order that they offer basic services at prices that are below their costs. The proper way to minimize the cost of such a program, however, is to set an initial level of support per line, make the support portable among competing service providers, and then to let competitive forces determine which carriers get to provide service and which do not. For example, if the *initial* level of support is based on the difference between the incumbent LEC's *actual* embedded cost per line and the basic residential service rate, competitive market forces will, over time, ensure that only the carrier with the lowest incremental cost of providing service will be the most successful at finding customers.[30] More importantly, for present purposes, the use of hypothetical and misleading costs generated by the Hatfield model (and others of that ilk) is decidedly *not* the economically correct way for sizing and minimizing the universal service support fund.

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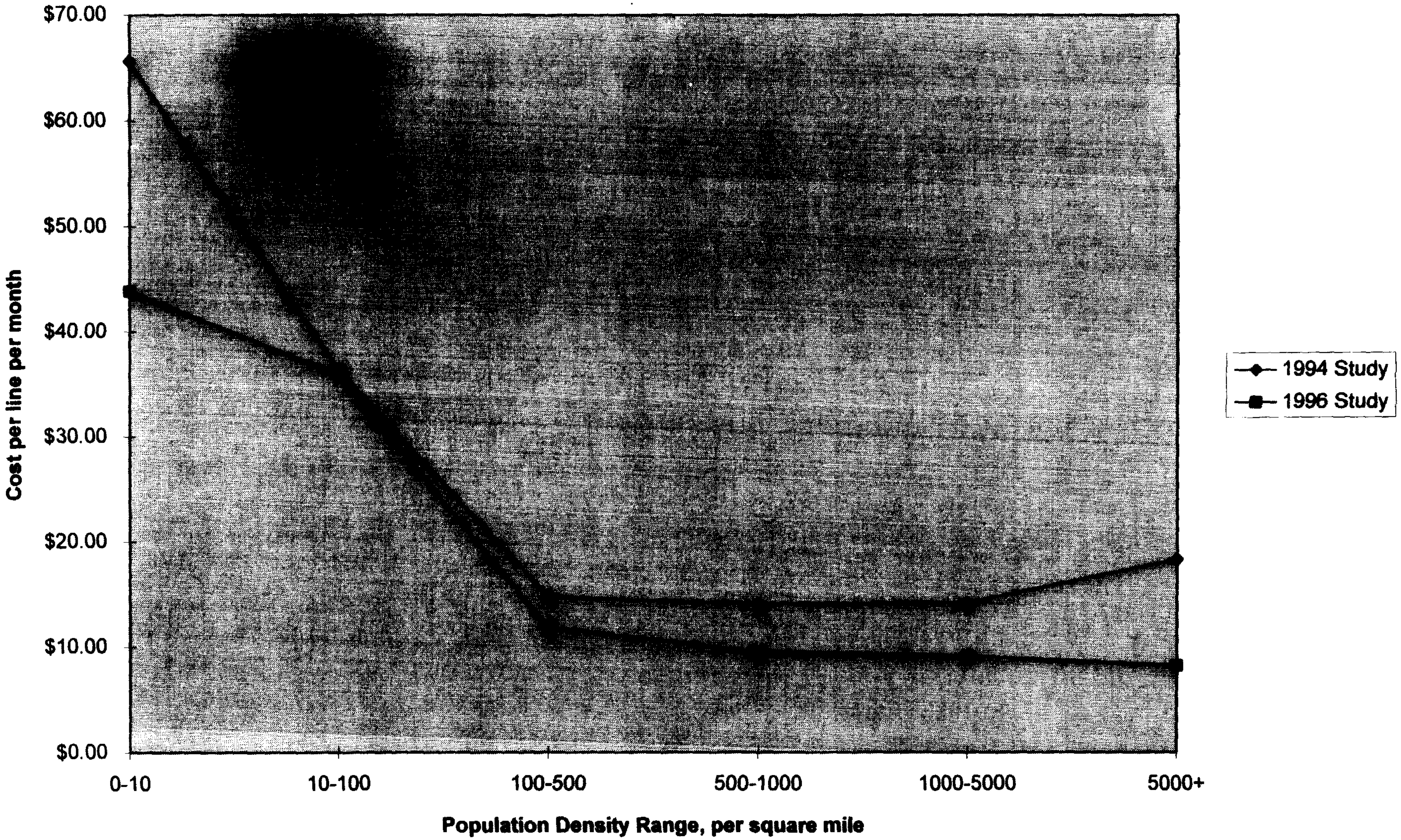
[30] The mechanism underlying this is fully described on pp. 9-14 of Kenneth Gordon and William Taylor, *Comments on Universal Service*, in this Docket, filed April 12, 1996. That mechanism eventually ensures competition based on carriers' *actual* incremental costs, and requires minimal intervention by regulators.

ATTACHMENT 4

COMPARISON OF 1994 AND 1996 HATFIELD STUDY RESULTS



CERTIFICATE OF SERVICE

I hereby certify that I have this 9th day of August, 1996 served all parties to this action with a copy of the foregoing FURTHER COMMENTS by placing a true and correct copy of the same in the United States Mail, postage prepaid, addressed to the parties on the attached service list.

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